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10/584,413	06/13/2007	Yuichiro Itai	1982-0288PUS1	9416

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EXAMINER	
CLARK, GREGORY D	
ART UNIT	**PAPER NUMBER**
1786	

NOTIFICATION DATE	DELIVERY MODE
10/05/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mailroom@bskb.com

Office Action Summary	Application No.	Applicant(s)	
	10/584,413	ITAI ET AL.	
	Examiner	Art Unit	
	GREGORY CLARK	1786	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _12 August 2010_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-21_ is/are pending in the application.

4a) Of the above claim(s) _2, 6 and 11-20_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1,3-5,8-10 and 21_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

The examiner acknowledges the receipt of applicants' amendments/arguments dated 08/12/2010.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. **Claims 1, 3-5, 7-10 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Oh (US 2003/0118866) in view of Zhou (Advanced Functional Materials 2001, No. 4, P. 310-314) and van Duren (Advanced Functional Materials, 2002, Vol. 12, No. 10, pages 665-669).**

2. **Regarding Claims 1, 4 and 21,** Oh discloses and organic electroluminescent device (OLED) with an organic multilayer composed of layers in the following order (paragraphs 10-16):

Anode

Hole injection layer (HIL)

Hole transport layer (HTL)

Light emitting Layer (luminescent layer)

Electron transporting layer (ETL)

Electron injecting layer (EIL)

Cathode

The above device disclosed by Oh shows:

HTL adjacent to the positive-electrode (anode) side of the luminescent layer

ETL adjacent to the negative-electrode (anode) side of the luminescent layer

HIL located between the HTL and positive-electrode (anode)

HIL adjacent to the anode (positive electrode)

Oh fails to show an EIL adjacent to the cathode (negative electrode) side of the organic emitting layer (luminescent layer).

The examiner takes the position that the EIL and ETL play similar roles in facilitating the flow of electrons.

For this reason, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have used one for the other as in Oh. Thus, rendering the EIL adjacent to the cathode (negative electrode) side of the organic emitting layer with the resulting device having similar performance.

Oh fails to mention the conductivity of the HIL continuously changes along a thickness direction of the HIL.

Zhou discloses an OLED with an HIL where the layer thickness can be controlled by an evaporation process and the concentration of the component(s) that makes up the layer affect the conductivity.

The thickness the HIL based the concentration component(s) that make up the layer is viewed as a cause effective variable to affect the conductivity of the HIL. Where an increased concentration of a given component would be expected to produce a layer with a high conductivity.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the thickness of the HIL to optimize the conductivity which would have included a continuous change along the thickness direction of the HIL.

Oh fails to mention a HIL that includes 2 an acceptor.

Zhou discloses an OLED where the HIL contains a strong acceptor, 2,3,5,6-tetrafluoro-7,7,8,8 tetracyanoquinodimethane (F4-TCNQ) (page 310) which leads to OLED(s) that exhibit lower driving and operating voltages (abstract).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have modified the HIL of Oh by including the acceptor taught by Zhou since Zhou discloses that the presence of an acceptor in the HIL leads to OLED(s) that exhibits lower driving and operating voltages.

Oh discloses the ITO (indium tin oxide) is used as an anode material (paragraph 20).

Oh and Zhou fail to mention the HIL has a border region with a reduced acceptor concentration formed in the vicinity of an interface between the hole injection layer and the anode.

van Duren discloses an anode composed of ITO adjacent to an organic layer (abstract). van Duren mention that indium from the ITO electrode can diffuse into the adjacent organic layer (page 667).

The examiner takes the position that the ITO/organic layer interface of van Duren is analogous to the ITO/ HIL interface taught by Oh in view of Zhou. Moreover, the ITO anode of Oh would in like fashion diffusion indium into the HIL layer. This diffusion would create a region at the interface comprising indium and the acceptor. As this interfacial contains an additional component (indium), the effective concentration of the acceptor is the border region would be reduced in compassion to the acceptor concentration in regions of the HIL further away from the border region.

3. **Regarding Claim 9**, Oh discloses an OLED where the HIL is made from copper phthaiocyanine (paragraph 11). Oh fails to mention a HIL made from 4,4',4"-tris(N, N-diphenylamino)triphenylamine (TDATA) .The use of F4-TCNQ as an acceptor in the HIL was discussed in section 3.

Zhou discloses an OLED with enhanced hole injection (abstract) where the HIL is made of a starburst amine, TDATA (page 310).

As the prior art teaches the use of phthaiocyanine and TDATA in a HIL of an OLED, these materials are considered as functional equivalents and would be readily exchangeable. An OLED with a HIL composed of TDATA would be expected to have similar properties to a HIL composed of phthaiocyanine.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have modified the HIL of Oh by adding the TDATA and F4-TCNQ of

Zhou since Zhou discloses the HIL shows enhanced hole injection with TDATA (abstract and page 310) and the OLED operates at a lower drive voltage with F4-TCNQ (abstract).

4. **Regarding Claim 3**, Oh, Zhou and van Duren teach the invention of claim1, Oh and Zhou fail to mention the acceptor in the HIL changes continuously along the thickness direction of the HIL.

Zhou discloses that TDATA and F4-TCNQ are prepared by coevaporation which can be controlled independently measuring them separately with quartz thickness monitors allowing the ratio to be controlled (gradient thickness) (page 311). Zhou mentions that the conductivity of the film (HIL) increases with dopant (F4-TCNQ) concentration (thickness).

Whereas Oh and Zhou teach the controlled thickness of F4-TCNQ in the HIL that affects conductivity, it would have been obvious to deposit the F4-TCNQ evenly (continuously) in the thickness direction across the HIL to ensure a uniform enhancement of conductivity.

5. **Regarding Claim 5 and 7**, Oh and Zhou teach the invention of claim1. Oh mentions the HIL adjacent to the HTL but fails to mention a border region with a reduced acceptor concentration formed in the vicinity of the HIL-HTL interface or that the acceptor concentration changes by at least 10% in the vicinity of the HIL-HTL interface.

Zhou discloses that TDATA and F4-TCNQ are prepared by coevaporation which can be controlled independently measuring them separately with quartz thickness monitors allowing the ratio to be controlled (gradient thickness) (page 311). Zhou mentions that the conductivity of the film (HIL) increases with dopant (F4-TCNQ) concentration (thickness).

The thickness of a given region of the HIL based the concentration of TDATA and F4-TCNQ is viewed as a cause effective variable to affect the conductivity of the HIL.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the acceptor concentration in the vicinity of the HIL-HTL interface to optimize the conductivity of the HIL which would have included a reduction in the acceptor concentration at the HIL-HTL interface and an acceptor concentration change by at least 10% in the vicinity of the HIL-HTL interface.

6. **Regarding Claim 8**, Oh, Zhou and van Duren teach the invention of claim 1, Oh and Zhou fail to mention the HIL has first and second border regions with reduced acceptor concentrations in the vicinity of the HIL-HTL interface and in the vicinity of another HIL-HTL interface and the positive electrode (anode), respectively.

Zhou discloses a method that control the thickness of the acceptor and indicates the doped (acceptor containing) HIL(s) give OLED(s) with lower driving voltages, lower operating voltages (abstract), and higher efficiencies (page 314).

The examiner takes the position that the interface between two organic layers would naturally allow for the diffusion of the components of one layer into the other. This diffusion would include the acceptor diffusing into the adjacent later which would establish an border region with a reduce acceptor concentration relative to the regions further away from the border region.

The reduced acceptor concentrations in the vicinity of another HIL interface and the positive electrode (anode) was addressed above.

7. **Regarding Claim 10,** Oh discloses an OLED where the positive electrode (anode) is made of indium-tin oxide (conductive oxide) (paragraph 10). Oh discloses that the HIL has a thickness of 10 to 30 nm. The applicant claims a thickness of 40-50 nm.

The thickness taught by Oh is not exactly the same as applicant but there is substantial overlap. It would have been obvious to a person of ordinary skill in the art at the time of the invention to have adjusted the thickness of the HIL to optimize the conductivity as discussed in section 5 which would have included the overlapping portion of the ranges, absent unexpected results.

Response to Arguments

The examiner has applied new art. As a result, the examiner will only address applicants' arguments not involving the new art.

Applicant argues that Oh fails to recite an EIL adjacent to the cathode. The examiner counters that the EIL and ETL play similar roles in facilitating the flow of electrons. For this reason, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have used one for the other as in Oh. Thus, rendering the EIL adjacent to the cathode (negative electrode) side of the organic emitting layer with the resulting device having similar performance.

Applicant argues that the references fail to teach the conductivity of the HTL changing continuously along a thickness direction of the HIL or controlling the leak current with a reduced acceptor concentration in the border region.

The examiner counters that Zhou discloses that TDATA and F4-TCNQ are prepared by coevaporation which can be controlled independently measuring them separately with quartz thickness monitors allowing the ratio to be controlled (gradient thickness) (page 311). Zhou mentions that the conductivity of the film (HIL) increases with dopant (F4-TCNQ) concentration (thickness). Whereas Oh and Zhou teach the controlled thickness of F4-TCNQ in the HIL that affects conductivity, it would have been obvious to deposit the F4-TCNQ evenly (continuously) in the thickness direction across the HIL to ensure a uniform enhancement of conductivity.

The examiner counter that applicant has not included any limitation with respect to the suppression of leak current. The arguments do not appear commensurate in scope with the claims.

Applicant has presented a number of examples in the arguments that show acceptor concentrations in the border region and argues that such reduced levels in the border regions give improved leak current values.

The examiner counters that in a multiple layer device where each layer also has multiple components there would naturally be border regions at the interface of two given layers. Whether the interface was between inorganic-organic layers (i.e.,ITO-HIL) or organic-organic layers (i.e.,HIL-HTL), one would have expected the formation of a border region at each interface where number of components in a given border region would be more that in the middle regions of the two layers based on diffusion from one or both layers which contribute to the interface. As a result, one would have expected the effective concentration of the components in the border regions to contain a reduced amount of any material that would naturally diffuse into the interface in comparison to said material a specific layer region away from the interface. As such, one would fully expect the acceptor concentration to be reduced in each border region. As applicant has not pointed to any special method to position the acceptor with a reduced concentration in a given border region. The examiner takes the position that the amount acceptor in a given border region is governed by diffusion.

As the mentioned above, the diffusion can be primarily from the indium (ITO) to establish inorganic-organic border region (ITO-HIL) which would effectively reduce the amount of the acceptor in said border region in comparison to the acceptor level in the region of the HIL away from the interface.

Likewise, the diffusion can be primarily from the organic components to establish organic-organic border region (HIL-HTL) which would effectively reduce the amount of the acceptor in said border region in comparison to the acceptor level in the region of the HIL away from the interface.

In either case, one would have expected a reduced acceptor level in the border regions. In the course of optimizing the device performance, one of ordinary skill in the art would have adjusted the acceptor levels in the HIL as the prior art points to improved hole injection that would be resultant. The optimized acceptor levels would have resulted in the establishment of border regions with reduced acceptor levels and the suppression of leak current claimed by applicant. As a result, applicants' results are not viewed as unexpected.

The applicant’s arguments with respect to claims 1, 3-5, 7-11 and 21 have been considered but are moot in view of the new grounds of rejection necessitated by the applicant’s amendment.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GREGORY CLARK whose telephone number is (571)270-7087. The examiner can normally be reached on M-Th 7:00 AM to 5 PM Alternating Fri 7:30 AM to 4 PM and Off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Larry Tarazano can be reached on (571) 272-1515. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/D. Lawrence Tarazano/
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GREGORY CLARK/GDC/
Examiner
Art Unit 1786